Section 3
Technology Applications Analysis

This section describes the Soil Rescue technology. It identifies the waste to which the technology is applicable and discusses the method of application used during the demonstration, materials handling requirements, the limitations of the technology, potential regulatory requirements, key features, the availability and transportability of the technology, and acceptance of the technology by state regulators and communities.

3.1 DESCRIPTION OF THE TECHNOLOGY

Soil Rescue is added to soils or wastes contaminated with toxic metals. Soil Rescue is an alkaline solvent made by a proprietary method that involves the extraction of organic acids and alcohols and the formation of phosphoryl esters in a batch process. Raw materials for the proprietary extractant include a medley of compost sources, which are extracted in a ratio that Star Organics has tested and found to provide the widest spectrum, and highest concentration, of desirable complexing components. Star Organics claims that Soil Rescue converts the metal contaminant from its leachable form to an insoluble, stable, nonhazardous, organometallic complex. Soil Rescue is a mixture of weak organic acids and phosphoryl esters that act as metal-complexing agents. In the complexation reaction, the metal ions, the organic acids and esters, and the soil substrate form coordinate covalent bonds. Star Organics claims that the formation of metal complexes by Soil Rescue reduces the waste stream's TCLP test results to less than the regulatory levels, thereby reducing the risks posed to human health and the environment (Star Organics 2000). The process generates no secondary wastes, and minimal handling, transportation, and disposal costs are incurred.

3.2 APPLICABLE WASTES

Star Organics claims that Soil Rescue can treat heavy metals in soils, sludges, mine tailings, and process residues and other solid waste. Star Organics states that Soil Rescue can stabilize the following heavy metals: barium, cadmium, chromium, copper, lead, mercury, selenium, and zinc (Star Organics 2000). Soil Rescue can be applied *in situ* at sites at which soils are moderately permeable. A second treatment may be necessary for more difficult metals (selenium), depending on the amount of contamination and the presence of competing metals in the soil (toxic and nontoxic).

3.3 METHOD OF APPLICATION

Farm or construction equipment can be used to apply Soil Rescue at large sites, and simple gardening or small construction equipment can be used at small treatment areas. For example, Soil Rescue was applied to the surface of the experimental units and injected to a depth of two feet with a pressurized sprayer.

Star Organics selects a site-specific concentration of Soil Rescue by determining the density, volume, weight, and amount of contamination present in the soil through bench-scale studies of soil samples. An evaluation of the soil chemistry at the site must be performed to determine the concentration of the contaminant throughout the site and the concentration of other metals that may be present at the site. Such site conditions as soil type, depth of contamination, and moisture content must be evaluated to determine the application procedure and equipment requirements.

The site should be accessible to wheeled or tracked vehicles and have sufficient space to store the equipment necessary to apply the technology. No utilities are required for the application of the technology. Potable water is required for decontamination of equipment and personnel.

3.4 MATERIAL HANDLING REQUIREMENTS

Soil Rescue is nonhazardous and requires no special handling procedures. All field equipment and personal protection equipment (PPE) must be decontaminated after the soil has been treated. For the CRPAC demonstration, decontamination was accomplished with soap, water, and Alconox, followed by a rinse with deionized water. While Soil Rescue is expected to generate little residual waste, any soil on the equipment, any fluids used in the decontamination process, and any disposable PPE must be treated as a potentially hazardous waste. The waste should be characterized for proper disposal.

3.5 LIMITATIONS OF THE TECHNOLOGY

In soils in which concentrations of other metals are high, it may be necessary to reapply Soil Rescue until the leachable concentration of the heavy metal is reduced to a level that is lower than the applicable cleanup standard. In addition, Soil Rescue appears to increase the potential that phosphates will leach from the treated soils and affect surface water.

3.6 REGULATORY REQUIREMENTS

This section discusses environmental regulations that may pertain to the application of Soil Rescue. The applicability of regulations to a particular remediation activity depends on the type of remediation site and the type of waste treated. Remedial managers also must address state and local regulations, which may be more stringent. ARARs for applications of Soil Rescue, although site-specific, may include the requirements of following federal regulatory programs: (1) the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); (2) RCRA; (3) OSHA; and (4) the Clean Water Act (CWA).

3.6.1 CERCLA

CERCLA, as amended by the SARA, provides for federal authority and funding to respond to releases or potential releases of any hazardous substance into the environment, as well as to releases of pollutants or contaminants that may present an imminent or significant danger to public health and welfare or to the environment. CERCLA is pertinent to a consideration of Soil Rescue because it governs the selection and application of remedial technologies at Superfund sites.

In general, two types of responses are possible under CERCLA: removal action and remedial action. Remedial actions are governed by the SARA amendments to CERCLA. SARA states a strong regulatory preference for innovative technologies that provide long-term protection and directs EPA to:

- Use remedial alternatives that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants
- Select remedial actions that protect human health and the environment, are cost-effective, and involve permanent solutions and alternative treatment or resource recovery technologies to the maximum extent possible
- Avoid off-site transport and disposal of untreated hazardous substances or contaminated materials when practicable treatment technologies exist [Section 121(b)]

SARA requires that on-site remedial actions comply with federal and more stringent state and local ARARs. ARARs are determined on a site-by-site basis and may be waived under any of six conditions: (1) the action is an interim measure, and the ARAR will be met at completion; (2) compliance with the ARAR would pose a greater risk to health and the environment than noncompliance; (3) it is technically impracticable to meet the ARAR; (4) the standard of performance of an ARAR can be met by an equivalent method; (5) a state ARAR has not been applied consistently elsewhere; or (6) compliance with the ARAR would not provide a balance between the protection achieved at a particular site and demands on Superfund for addressing other sites. The waiver options apply only to Superfund actions taken on site, and justification for the waiver must be demonstrated clearly (EPA 1988).

3.6.2 RCRA

RCRA, as amended by HSWA, regulates management and disposal of municipal and industrial solid wastes. EPA and the states implement and enforce RCRA and state regulations. Some of the RCRA Subtitle C (hazardous waste) requirements under 40 CFR parts 254 and 265 may apply at CERCLA sites because remedial actions generally involve treatment, storage, or disposal of hazardous waste. However, requirements under RCRA may be waived for CERCLA remediation sites, provided equivalent or more stringent ARARs are met.

RCRA regulations define hazardous wastes and regulate their transportation, treatment, storage, and disposal. The regulations are applicable to uses of Soil Rescue only if hazardous wastes as defined under RCRA are present. If soils are determined to be hazardous under RCRA (either

because of a characteristic identified in RCRA or listing of the waste, the remedial manager must address all RCRA requirements governing the management and disposal of hazardous waste. Criteria for identifying characteristic hazardous wastes are set forth in 40 CFR part 261 subpart C. Listed wastes from specific and nonspecific industrial sources, off-specification products, cleanups of spills, and other industrial sources are itemized 40 CFR part 261 subpart D.

Residual wastes generated during the application of Soil Rescue must be stored and disposed of properly. If the treated waste is a listed waste, residues of treatment must be considered listed wastes (unless delisting requirements under RCRA are met). If the residues are not listed wastes, they should be tested to determine whether they are characteristic hazardous wastes as defined under RCRA. If the residues are not hazardous and do not contain free liquids, they can be disposed of in a Subtitle D facility. If the residues are hazardous, the following RCRA standards apply:

- Standards and requirements for generators of hazardous waste, including hazardous treatment residues, are set forth at 40 CFR part 262. The requirements include obtaining an EPA identification number, meeting waste accumulation standards, labeling wastes, and keeping appropriate records. Part 262 allows generators to store wastes for as much as 90 days without a permit. If residues of treatment are stored on site for 90 days or more, requirements set forth at 40 CFR part 265 are applicable.

- Any on- or off-site facility designated for permanent disposal of residues of hazardous treatment must be in compliance with RCRA. Disposal facilities must fulfill the permitting, storage, maintenance, and closure requirements at 40 CFR parts 264 through 270. In addition, any authorized state RCRA requirements must be fulfilled. If treatment residues are disposed of off site, transportation standards set forth at 40 CFR part 263 are applicable.

3.6.3 OSHA

OSHA regulations at 29 CFR parts 1900 through 1926 are designed to protect the health and safety of workers. Corrective actions undertaken under both Superfund and RCRA must meet OSHA requirements, particularly those set forth at Section 1910.120, Hazardous Waste Operations and Emergency Response. Any more stringent state or local requirements must also be met. In addition, health and safety plans for site remediation projects should address chemicals of concern and include monitoring practices to ensure that the health and safety of works are protected. PPE must be worn to protect field personnel from known or suspected physical hazards, as well as air- , soil- , and water-borne contamination. The levels of PPE to be used for work tasks must be selected on a site-specific basis. The level of PPE should be based on known or anticipated physical hazards and concentrations of contaminants that may be encountered at a particular site and their chemical properties, toxicity, exposure routes, and contaminant matrices. Personnel must wear PPE when site activities involve known or suspected atmospheric contamination; when site activities might generate vapors, gases, or particulates; or when direct contact with substances that affect the skin may occur. Full-face respirators may be necessary to protect lungs, the gastrointestinal tract, and eyes against airborne contaminants. Chemical-resistant clothing may be needed at certain sites to protect the skin from contact with chemicals that are absorbed through or destructive to the skin.

The information provided by Star Organics and the results of observations made during the demonstration project indicate that the contaminants being treated usually are the determinating factor in the selection of PPE for applications of Soil Rescue. In general, latex or nitrile gloves, Tyvek coveralls, boot covers, and goggles are recommended for applying Soil Rescue to contaminated soils.

3.6.4 CWA

The CWA is designed to restore and maintain the chemical, physical, and biological quality of navigable surface waters by establishing federal, state, and local discharge standards. The CWA may affect application of the technology because it governs the appropriate manner of managing water used for decontamination activities. Depending on the concentrations of the contaminants in the wastewater and any permit requirements, contaminated water from the decontamination procedures could be discharged to a publicly owned treatment works (POTW). Each POTW has a different limit for lead that is specified in the POTW's National Pollutant Discharge Elimination System (NPDES) permit. The POTW will require disclosure of the contents of the wastewater and will determine whether contaminants will interfere with the treatment of the wastewater.

3.7 AVAILABILITY AND TRANSPORTABILITY OF THE TECHNOLOGY

Soil Rescue is available from Star Organics, Dallas, Texas (see Section 1.4 for the address and other contact information). Soil Rescue is nonhazardous and was

transported to the CRPAC demonstration site by a medium-duty truck. No special permit or licensing was required for transport of the material, and there are no restrictions on the transportation of the material. All equipment necessary for the application of Soil Rescue is readily available from local rental companies and need not be obtained from Star Organics.

3.8 COMMUNITY ACCEPTANCE BY THE STATE AND THE COMMUNITY

State and community acceptance of Soil Rescue on the part of state regulatory agencies and affected communities likely will be site-specific. Because no community outreach program has been established for the CRPAC, it is difficult to predict how communities in the vicinity of the CRPAC will accept Soil Rescue.

This economic analysis presents two cost estimates for the application of Soil Rescue (not including profit) to commercially remediate soil contaminated with lead. The estimates are based on assumptions and costs provided by Star Organics; data compiled during the SITE demonstration; and additional information obtained from current construction cost estimating guidance, as well as experience under the SITE Program. Costs for the technology can vary, depending on soil conditions, regulatory requirements, and other site- and waste-specific factors.

Two estimates are presented in this analysis to determine the costs of applying Soil Rescue. The first estimate (Case 1) is based on costs incurred during the SITE demonstration. The total volume of soil treated at the CRPAC demonstration site was approximately 5 cubic yards. That volume was spread over ten 5-foot-by-5-foot-by-0.5 foot plots and one 6-foot-by-3-foot-by-0.5 foot plot. The second estimate (Case 2) is for a hypothetical one-acre site at the CRPAC that would be treated to depth of 0.5-foot. Case 2 represents a typical application of Soil Rescue. The cost estimate for Case 2 is based on extrapolation of data from the costs of the SITE demonstration. For Case 2, the total volume of soil to be treated is 807 cubic yards. Two scenarios are presented because of certain "fixed" costs related to the use of the technology; the unit cost per volume drops significantly when it is applied to larger volumes of material.